One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

Evaluation Board for Fractional-N PLL Frequency Synthesizer

FEATURES

Self-contained board including synthesizer, VCO, 10 MHz TCXO reference, USB interface, voltage regulators, and loop filter (5.8 GHz)
Designed for 10 MHz PFD frequency, minimum charge pump current, and 20 kHz loop bandwidth
Accompanying software allows control of synthesizer functions from a PC (via USB interface)
Battery operated: choice of 3 V or 5 V supplies

GENERAL DESCRIPTION

The EVAL-ADF4158EB1Z evaluates the performance of the ADF4158 frequency synthesizer for phase locked loops (PLL). A digital picture is shown in Figure 1. It contains the ADF4158 synthesizer, a PC connector, SMA connectors for the power supplies, and an RF output. There is also a low pass loop filter (20 kHz) and a VCO (Z Communications, Inc., VCO940ME03 5.8 GHz) on board. The evaluation board is set up for a 10 MHz PFD comparison frequency. An on-board TCXO provides the 10 MHz reference frequency. A USB cable is included with the board to connect to a PC USB port.

The package also contains Windows® software (2000- and XP-compatible) to allow easy programming of the synthesizer.

EVALUATION KIT CONTENTS

Antistatic bag with USB warning label (free issue by Analog Devices, Inc.)
Fractional-N synthesizer CD (with USB control) (issue by Analog Devices)
Evaluation board box (Europaks K-645/1) with EVAL-ADF4158EB1Z barcode label
Wrapping material (antistatic bubble wrap)

DIGITAL PICTURE OF THE EVALUATION BOARD

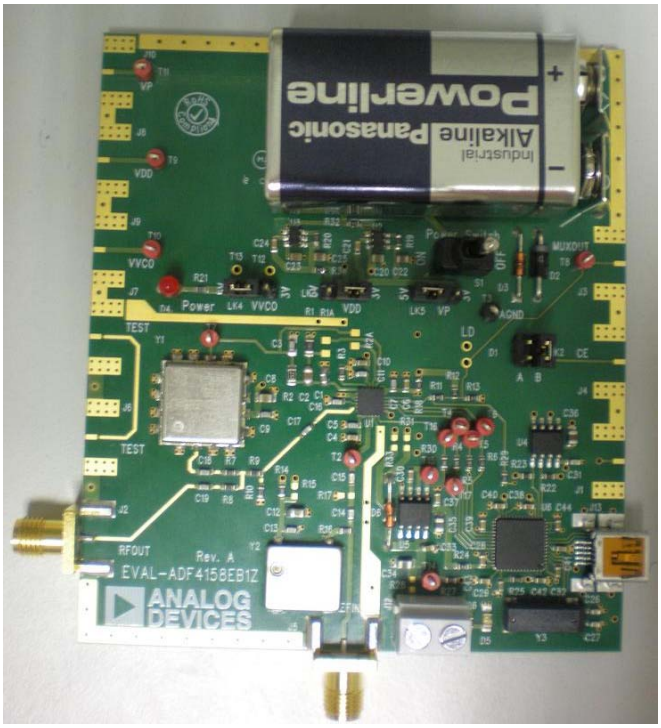

Figure 1.

TABLE OF CONTENTS

Features 1
General Description 1
Evaluation Kit Contents 1
Digital Picture of the Evaluation Board 1
Revision History 2
Evaluation Board Hardware 3
Overview 3
Power Supplies 3
Loop Filter 3
Local Oscillator Components 3
Evaluation Setup 4
Evaluation Board Software 5
Main Window 5
Ramp Setup Window 5
Evaluation Board Schematic 8
Ordering Information 11
Bill of Materials 11

REVISION HISTORY

5/10—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

OVERVIEW

The EVAL-ADF4158EB1Z is supplied with a cable for connecting to the USB port of a PC. The silk screen for the evaluation board is shown in Figure 2. The board schematic is shown in Figure 7, Figure 8, and Figure 9.

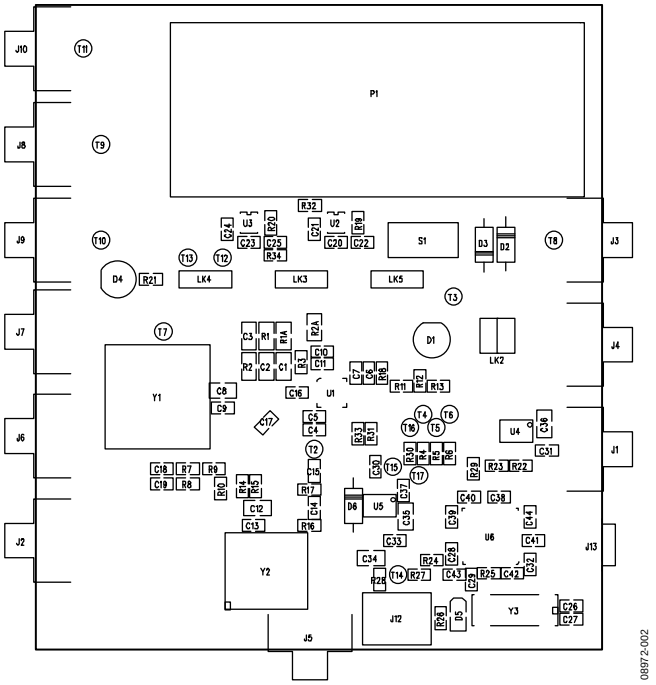

Figure 2. Evaluation Board Silk Screen

POWER SUPPLIES

The board is powered from a single 9 V battery. The power supply circuitry allows the user to choose 3 V for the AV_{DD}, DV_{DD}, and SDV_{DD} pins of the ADF4158 and either 3 V or 5 V for the V_P pin of the ADF4158 and for the VCO supply. The default settings are 3 V for AV_{DD}, DV_{DD}, and SDV_{DD} and 5 V for V_P.

It is very important to note that the AV_{DD}, DV_{DD}, and SDV_{DD} pins of the ADF4158 should never exceed the V_P pin of the ADF4158. This can cause damage to the device.

If the user wishes, external power supplies can be used. In this case, insert SMA connectors as shown on the silk screen (see Figure 2) and the digital picture (see Figure 1) of the evaluation board.

LOOP FILTER

The loop filter schematic is included in the board schematic in Figure 7, Figure 8, and Figure 9. The loop filter component placements are clarified in Figure 3.

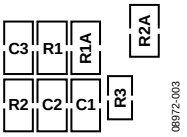

Figure 3. Loop Filter Placement

LOCAL OSCILLATOR COMPONENTS

The 10 MHz TCXO provides the reference frequency. The on-chip R divider should be set to 1 so that the PFD frequency is also 10 MHz. The PLL is made up of the 10 MHz TCXO, the ADF4158, a passive loop filter (20 kHz bandwidth), and the VCO V940ME03 VCO from Z Communications. The output is available at RF_{OUT} through a standard SMA connector.

The on-board loop filter has been designed for a charge pump current of 0.3125 mA. ADIsimPLL, a free download available at www.analog.com/pll, can be used to design other loop filters.

EVALUATION SETUP

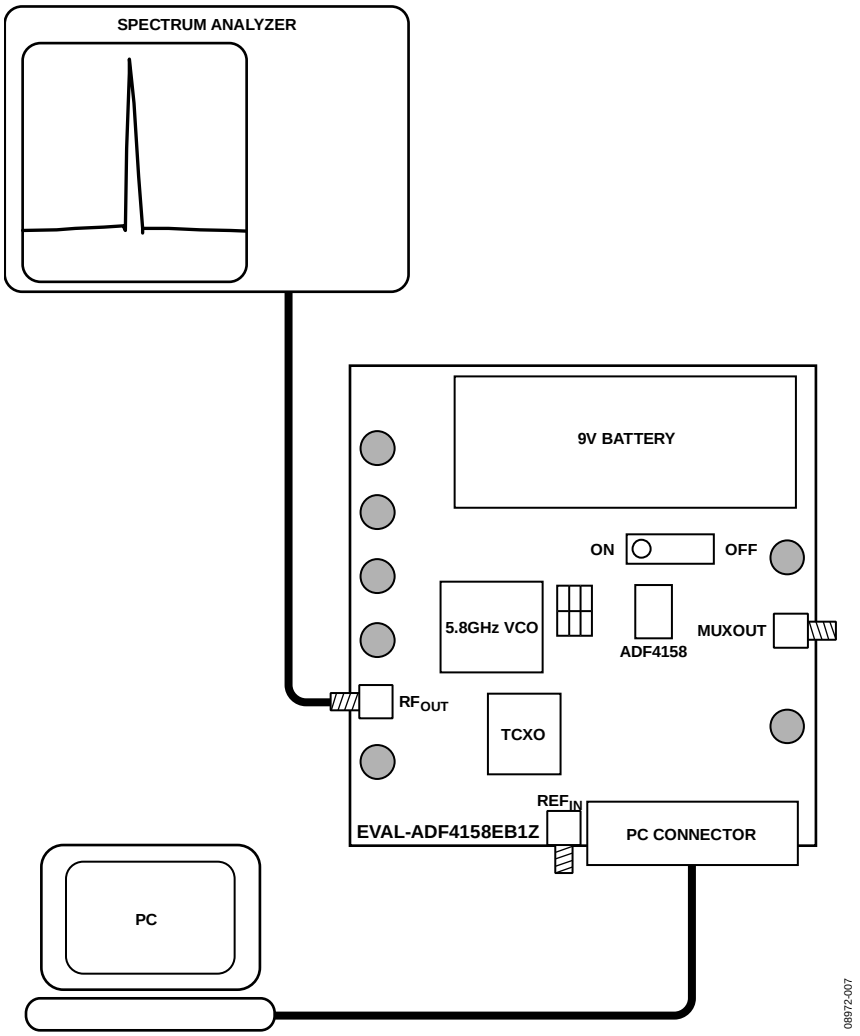

Figure 4. Evaluation Setup

EVALUATION BOARD SOFTWARE

The control software for EVAL-ADF4158EB1Z is on the CD that accompanies the board. To set up the software, use the following steps:

1. Click **setup.exe**.
2. The installation wizard appears. Follow the on-screen instructions.
3. The software is installed in a default directory called **C:/Program Files/Analog Devices/ADF4x5x**. To run the software, click the .exe file. Ensure that Version 3.3 was downloaded (**Help** > **About**).

While starting the software, choose **USB Port** in the **Communication Selection** section of the device window. The EVAL-ADF4158EB1Z cannot be programmed by the parallel port. Once the board is detected, a blue **USB Detected** box appears in the bottom left corner of the main window (see Figure 5).

MAIN WINDOW

In the main window, basic PLL settings can be chosen (see Figure 5). Most important are the parameters in both RF sections. Initially they are set to values that allow for correct operation of the EVAL-ADF4158EB1Z. The RF VCO output frequency should be within the range of the chosen VCO. The PFD frequency should be the value for which the loop filter was designed. REF_{IN} frequency should be the same as the applied reference signal. For VCO frequencies below 3 GHz, use a prescaler of 4/5 and for VCO frequencies above 3 GHz, use a prescaler of 8/9

In the RF section on the right side, program the charge pump current setting to the value for which the loop filter was designed. Charge pump polarity should usually be positive unless inverting active loop filter configuration is used. The **CSR Disabled/CSR Enabled** button offers cycle slip reduction (one of the fast-lock mechanisms). The **RF Counter Reset Disabled/RF Counter Reset Enabled** button brings PLL counters out/in of the reset state. The **CP 3 State Off/CP 3 State On** button brings the charge pump out/in of tristate.

In the top left corner, the **RF Powerdown Disabled/RF Powerdown Enabled** button powers up/down the part. The **Program Fast Lock** button is used for configuring switched-R fast lock. The **Fastlock Disabled/Fastlock Enabled** button is used for deactivating/activating switched-R fastlock. The **LDP = 3** button is used for setting lock detect precision. **Muxout** chooses the signal that is connected to the output of the multiplexer.

In the bottom right corner, the **FSK Setup** button opens the window for setting FSK modulation parameters, the **PSK Setup** button opens the window for activating PSK modulation, the **Ramp Setup** button programs ramps, and the **Frequency Hop** button enables jumping between frequencies.

RAMP SETUP WINDOW

The **Ramp Setup** window chooses various types of ramps with their specific options (see Figure 6). Ramp selection allows for selecting a continuous triangular, sawtooth ramp, single sawtooth burst ramp, or single ramp burst. Basic settings that configure a ramp are located in the **Deviation Frequency/No of Steps** and **Timer Setting** sections. **Deviation Frequency** determines the frequency step of a ramp, and **Dev. Offset** sets frequency resolution. **Dev. Freq. Res.** specifies is the smallest frequency deviation that can be used. Use a small value of frequency resolution for precise but short ramps and big value of frequency resolution for long, but less precise ramps. The **No. of steps** text box determines the number of steps that comprise a ramp. The **Timer** text boxes are used for setting the duration of a single step.

After choosing the aforementioned settings, activate the ramp by clicking the **Start Ramp** button in the bottom right corner of the software window.

The software also allows for evaluating other ADF4158 features: frequency readback, dual ramp rates mode, ramp mode with FSK signal on ramp, delayed start, and delay between ramps.

In the **Dual Ramp Rates Mode** section, program both **Ramp1** and **Ramp2**. This is done by selecting **On** and **Ramp1** first. Once **Ramp1** is selected, settings for this particular ramp should be updated in the **Deviation Frequency/No of Steps** and **Timer Setting** sections. Then select **Ramp2**; settings for this ramp should also be updated in the **Deviation Frequency/ No of Steps** and **Timer Setting** sections.

In the **Ramp Mode with FSK Signal on Ramp** section, set the deviation frequency of the FSK signal superimposed on a ramp. Ramp settings are chosen in **Deviation Frequency/No of Steps** and **Timer Setting** sections.

The **Delayed Start** section chooses the delay of the ramp's start. The first option (Delay = t_{PFD} × Delay Word) should be selected for short delays (it also gives better resolution of time delay). The second option (Delay = t_{PFD} × MOD × Delay Word) should be selected for long delays.

The **Delay between Ramps** section chooses the delay between ramps. The first option (Delay = t_{PFD} × Delay Word) should be selected for short delays (it also gives better resolution of time delay). The second option (Delay = t_{PFD} × MOD × Delay Word) should be selected for long delays. There is also a fast-lock option in this section, which can be used for reducing the overshoot in a sawtooth ramp.

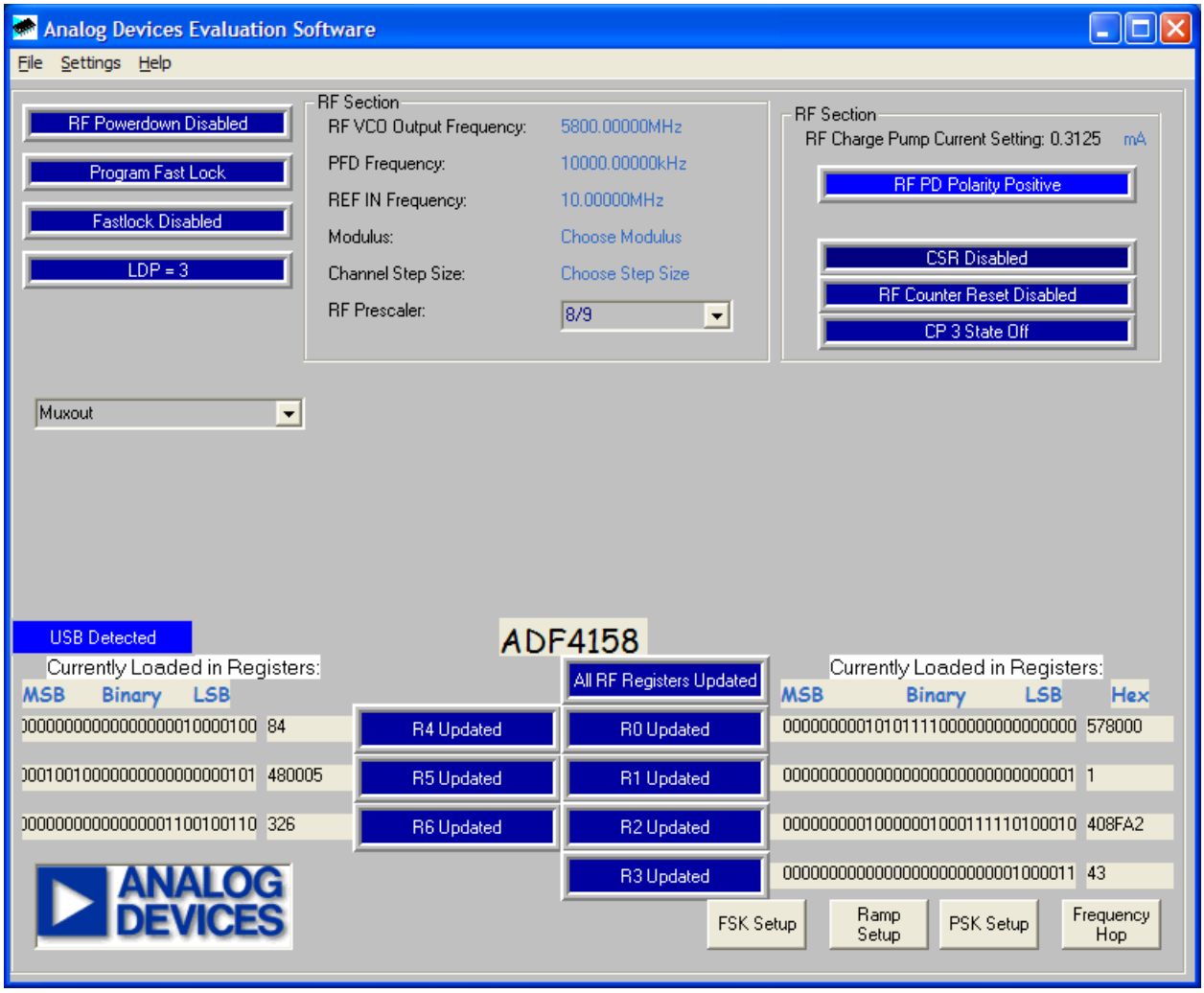

Figure 5. Software Main Window

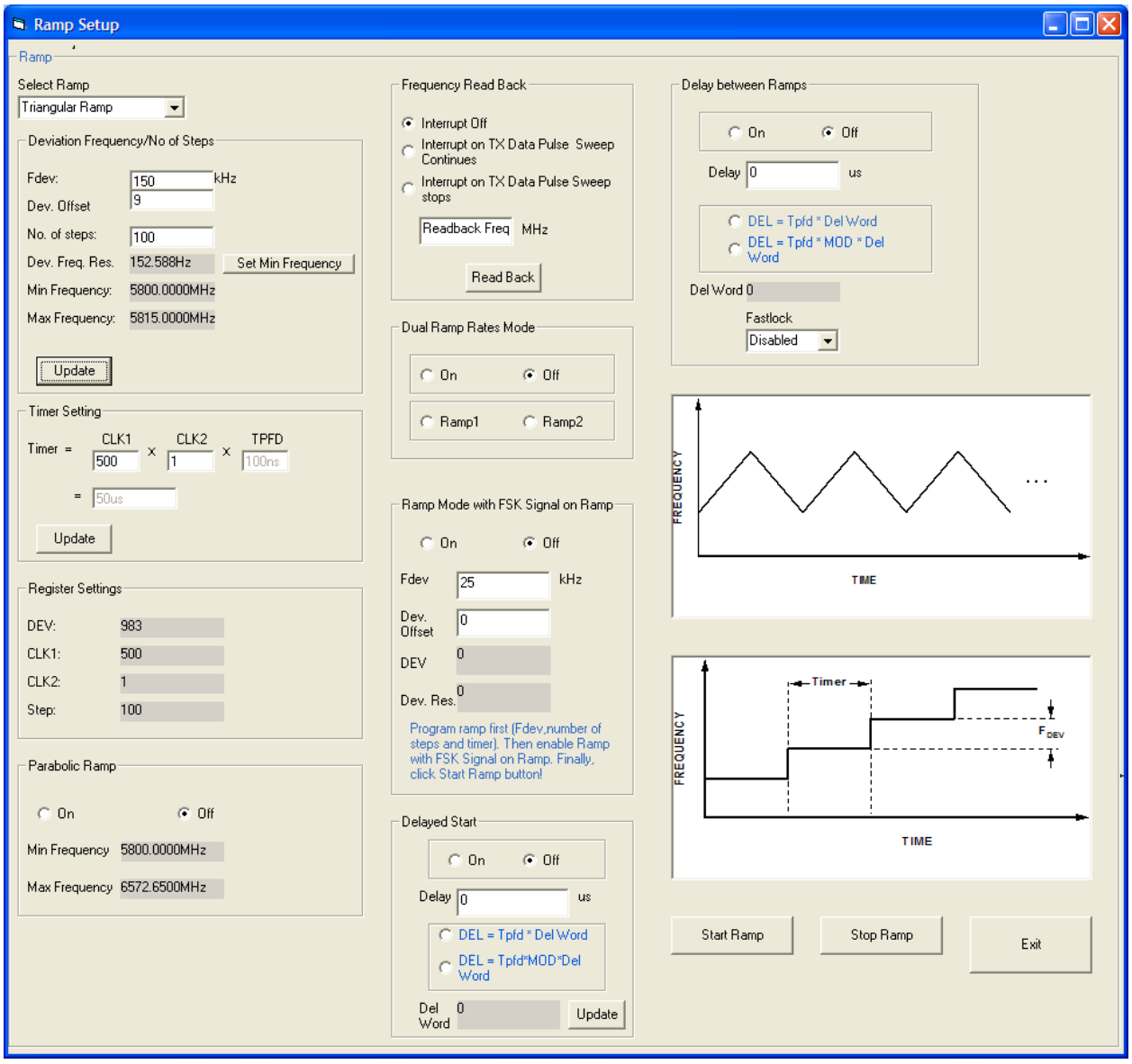

Figure 6. Ramp Setup Window

EVALUATION BOARD SCHEMATIC

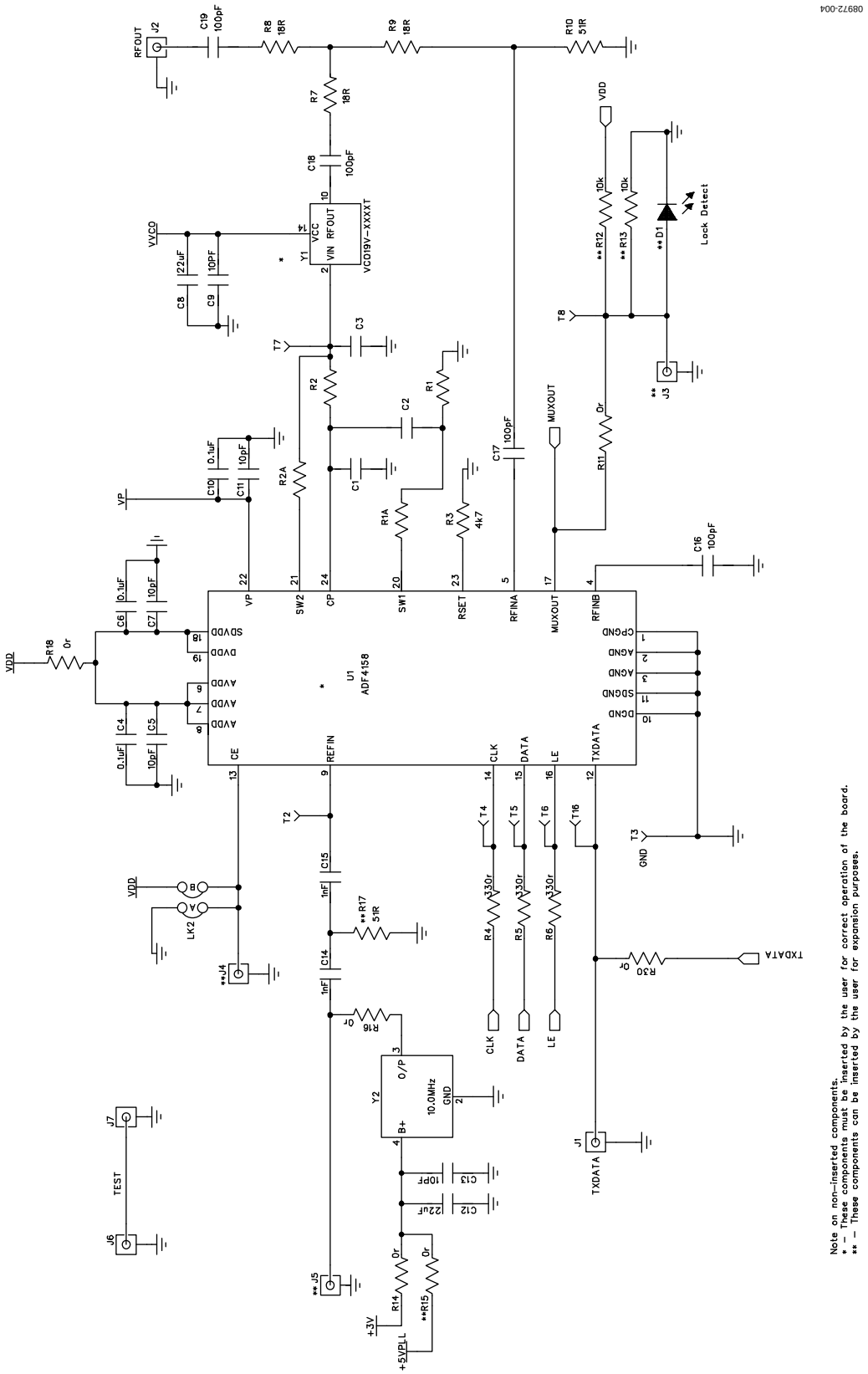

Figure 7. Evaluation Board Schematic (Page 1)

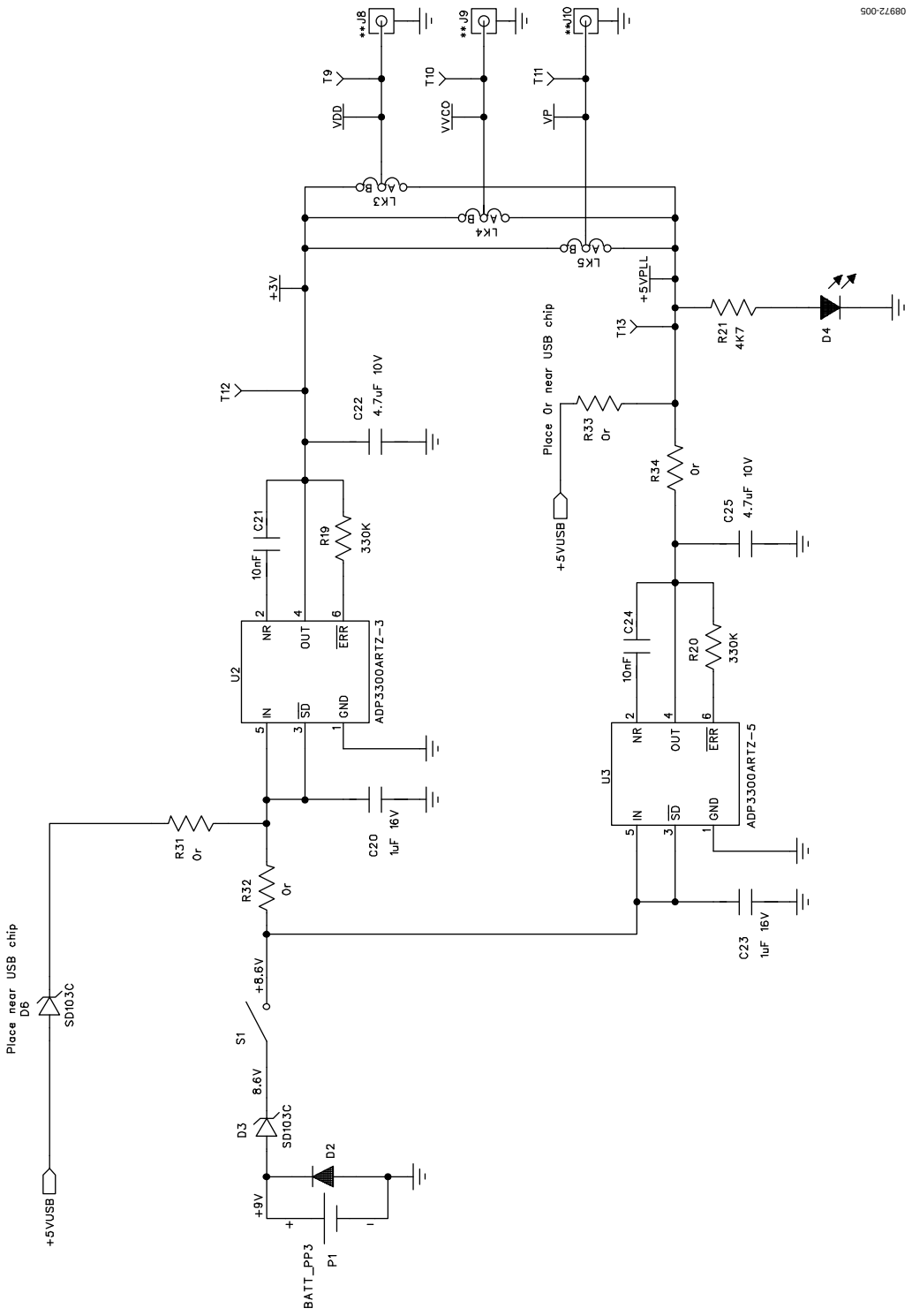

Figure 8. Evaluation Board Schematic (Page 2)

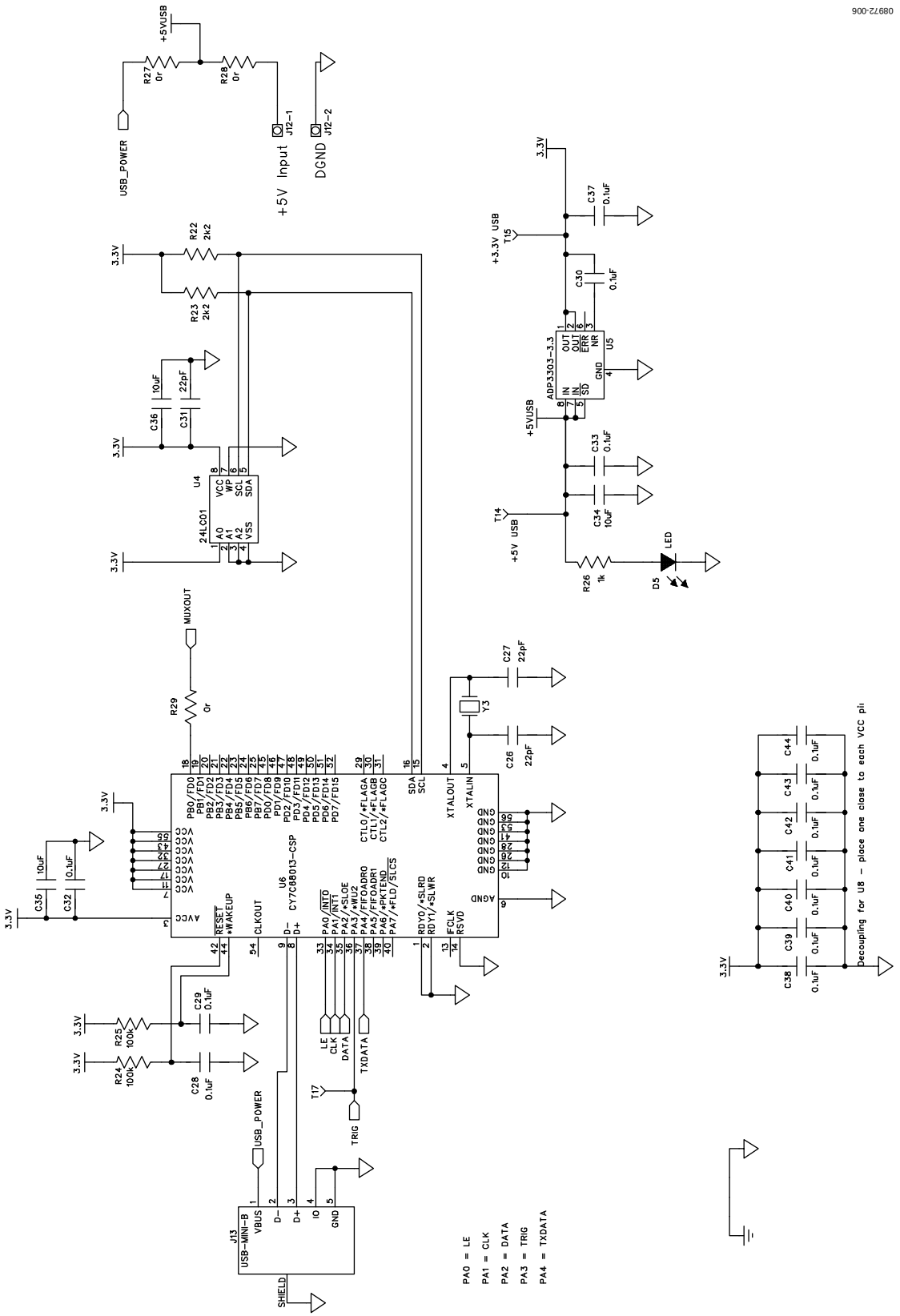

Figure 9. Evaluation Board Schematic (Page 3)

ORDERING INFORMATION

BILL OF MATERIALS

Table 1.

Reference Designator	Description	Manufacturer/Part Number	Supplier Stock Code
C1	Capacitor 680 pF 0603	MCCA000220	FEC 1759083
C2	Capacitor 8.2 nF 0603	MCCA000236	FEC 1759101
C3	Capacitor 330 pF 0603	MCCA000212	FEC 1759075
C4, C6, C10, C28 to C30, C37 to C44	Capacitor 0.1 µF 0603	CM105X7R104K16AT	FEC 1216538
C5, C7, C9, C11, C13	Capacitor 10 pF 0603	06035A100JAT2A	FEC 499110
C8, C12	Capacitor 22 µF 0805	GRM21BR60J226ME39L	Digi-Key 490-1719-1-ND
C14, C15	Capacitor 1 nF 0603	06035A102JAT2A	FEC 317202
C16 to C19	Capacitor 100 pF 0603	06035A101JAT2A	FEC 499122
C20, C23	Capacitor 1 µF 16 V 0603	GRM188R71C105KA12D	Digi-Key 490-3900-1-ND
C21	Capacitor 10 nF 0603	CC0603KRX7R8BB103	FEC 3019561
C22, 25	Capacitor 4.7 µF 10 V 0603	LMK107BJ475KA-T	Digi-Key 587-1441-1-ND
C24	Capacitor 10 nF 0603	CC0603KRX7R8BB103	FEC 3019561
C26, C27, C31	Capacitor 22 pF 0603	06035A220JAT2A	FEC 498543
C32, C33	Capacitor 0.1 µF 0603	CM105X7R104K16AT	FEC 1216538
C34 to C36	Capacitor 10 µF 0805	GRM21BR71A106KE51L	Digi-Key 490-3905-1-ND
D1	LED	DNI	DNI
D2	Diode 1N4001 DO-41	1N4001	FEC 9564993
D3, D6	SD103C 20 V DO35	SD103C-TP	Digi-Key SD103CTPMSCT-ND
D4	Red LED	TLLR4401	FEC 1045504
D5	Green LED 0805	HSMG-C170	FEC 579-0852
J1 to J10	SMA SMA_CARD_EDGE_RF_VIAS	142-0701-851	FEC 1019325
J12	CON\POWER	CTB5000/2	FEC 151789
J13	USB-MINI-B	56579-0576	FEC 9786490
LK2	JUMPER_2_INVTEXT	M20-9980345 and M7567-05	FEC 1022230 and FEC 150410
LK3 to LK5	JUMPER2\SIP3, LINK-3P-NOTEXT	M20-9980345 and M7567-05	FEC 1022248 and FEC 150410
P1	BATT_PP3	593+594	FEC 723988
R1	Resistor 2.4 kΩ 0805	MC 0.1W 0805 1% 2K4	FEC 9332880
R1A	Resistor DNI 0805	DNI	DNI
R2	Resistor 5.1 kΩ 0805	MC 0.1W 0805 1% 5K1	FEC 9333320
R2A	Resistor DNI 0805	DNI	DNI
R3, R21	Resistor 4.7 kΩ 0603	MC 0.063W 0603 4K7	FEC 9331247
R4, R5, R6	Resistor 330 Ω 0603	MC 0.063W 0603 330R	FEC 9331018
R7, R8, R9	Resistor 18 Ω 0603	MC 0.063W 0603 18R	FEC 9330747
R10, R17	Resistor 51 Ω 0603	MC 0.063W 0603 51R	FEC 9331336
R11	Resistor 0 Ω 0603	MC 0.063W 0603 0R	FEC 9331662
R12, R13	Resistor 10 Ω 0603	MC 0.063W 0603 10K	FEC 9330399
R14, R15, R16, R18, R27, R28, R30 to R34	Resistor 0 Ω 0603	MC 0.063W 0603 0R	FEC 9331662
R19, R20	Resistor 330 Ω 0603	MC 0.063W 0603 330K	FEC 9331042
R22, R23	Resistor 2.2 kΩ 0603	MC 0.063W 0603 2K2	FEC 9330810
R24, R25	Resistor 100 Ω 0603	MC 0.063W 0603 100K	FEC 9330402
R26, R29	Resistor 1 Ω 0603	MC 0.063W 0603 1K	FEC 9330380
S1	SW_POWER, SW_SIP-3P	TL36P0050	FEC 1082496
T2, T4 to T17	Test point	20-313137	FEC 8731144
T3	Test point	20-2137	FEC 8731128

Reference Designator	Description	Manufacturer/Part Number	Supplier Stock Code
U1	Fractional-N frequency synthesizer	Analog Devices ADF4158BCPZ	ADF4158BCPZ
U2	Low dropout linear regulator	Analog Devices ADP3300ARTZ-3	ADP3300ARTZ-3
U3	Low drop out linear regulator	Analog Devices ADP3300ARTZ-5	ADP3300ARTZ-5
U4	IC EEPROM 64 kB 400 KHz	Microchip Technologies24LC64-ISN	Digi-Key 24LC64-I/SN-ND
U5	Low drop out linear regulator	Analog Devices ADP3303ARZ-3.3	ADP3303ARZ-3.3
U6	USB microcontroller	Cypress Semiconductor CY7C68013A-56LFXC	Digi-Key 428-1669-ND
Y1	Voltage controlled oscillator	Z Communication VCO V940ME03	VCO V940ME03
Y2	OSC_TCXO 10.0 MHz OSC_TCXO	801-BELF-100	Fox 801-BELF-100 (10 MHz)
Y3	XTAL-CM309S 24 MHz	X24M000000S244	FEC 9509658
	9 V PP3 battery	GP1604-10	FEC 5057050
	Rubber stick-on feet 4×	SJ5076BLACK	FEC 1165061
	Bare PCB	Analog Devices EVAL-ADF4158EB1Z	EVAL-ADF4158EB1Z
	Cable MINI-USB A to MINI-B 1M	Hirosi Electric Co., Ltd. UX40-MB-5PA-1000-2003	Digi-Key H2957-ND

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS ($100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

©2010 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners.
UG08972-0-5/10(0)

www.analog.com